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This is a Patent Cooperation Treaty patent application under 35 USC §371 claiming the filing date of U.S. Patent Application Serial No. 60/553,576 filed in the United States Patent and Trademark Office on March 15, 2004, pursuant to 35 USC §120.

IMPROVED HIGHLY SUPERHEATED VAPOR GENERATING SYSTEM AND METHOD

FIELD OF THE INVENTION

The invention pertains to superheated vapor generators and systems for delivering highly superheated vapor flows as well as methods of fabrication and use of such superheated vapor generators and systems for providing desired flows of highly superheated vapor including substantially continuous flows.

DESCRIPTION OF THE PRIOR ART

Prior patents include U.S. Pat No. 6,006,009 (the `009 Patent), U.S. Pat. No. 5,471,556 (the `556 Patent) and U.S. Pat No. 4,414,037 (the `037 Patent) owned by the inventor and applicant herein, co-pending U.S. Pat. Application Ser. No. 08/484,019 owned by the applicant and inventor herein for Superheated Vapor Generator and Control System and Method, all incorporated by reference herein, references cited in connection with aforesaid U.S. Pat. No. 4,414,037 including U.S. Pat. Nos. 2,505,656; 2,753,212; 2,861,838; 2,983,450; 3,039,454; 3,218,741; 3,718,805 and 3,721,802. and patents cited in connection with said U.S. Pat. No. 5,471,556 including U.S. Pat. Nos. 377,228; 2,652,645; 3,436,852; 3,119,004; 3,869,815; 4,255,646; 3,508,354; 3,823,497; and 2,576,976.

The aforesaid references in the main refer to apparatus and methods for generating steam from liquid drawn from a reservoir.

The '037 Patent discloses apparatus for generating superheated steam or other vapor from liquid drawn from a self-contained reservoir and includes means in the

form of a nozzle for directing superheated steam or other vapor to desired locations. The '556 Patent discloses improvements relative to the '037 Patent. Said co-pending application discloses further improvements.

Equipment disclosed in the aforesaid patents and co-pending application is employable for effecting, among other things, cleaning and/or sterilization. This apparatus has proved highly useful for such purposes. In operation, such equipment provides flows of superheated vapor upon activation of a control member.

The vapor stream issues, in particular applications, from either a port mounted on the generator or from a wand/extender whereby distance of the transported vapor may be extended to one hundred feet or more. Of course, there is an unavoidable loss of pressure and exit temperature in such apparatus employing extenders for transporting the superheated vapor over appreciable distances.

Advantages of transporting superheated high pressure vapor with high heat are particularly apparent in applications such as sterilizing narrow or relatively inaccessible sites such as air conditioning and heating ducts, destroying and removing mold from surfaces which may be small or relatively inaccessible, among many others.

Further advantages of such extended transportation of superheated vapor at high pressure are in the capability to sterilize or clean areas which require use of explosion proof equipment in their vicinity, whereby the controls and electrical aspects of the system are substantially removed from the sensitive regions.

In addition, regardless of the distance of transport of superheated vapor, there are numerous benefits and advantages in connection with even further increasing temperatures of the superheated vapor from those provided by existing systems. Some of these advantages include the final product, i.e., superheated vapor, even further removal of moisture content and correspondingly greater proportion of vapor as opposed to liquid. This provides a greater capability of delivering extreme heat and temperature to selected targets as for example regions for soldering or welding, with relative security against explosion.

Accordingly, there has been a felt but unfulfilled need for systems and methods for increasing the temperature and pressure of superheated vapor issuing from superheated vapor generators for the purpose of increasing efficiency and delivery of such vapor at varying distances from the source of the vapor.

SUMMARY OF THE INVENTION

A system and method for further heating superheated vapor comprises means connectable to superheated vapor generator apparatus for receiving and disseminating superheated vapor and for further heating said superheated vapor prior to dissemination and comprises the steps of producing superheated vapor, circulating said superheated vapor for dissemination and further heating prior to issuance of said superheated vapor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a system in accordance with the invention;

FIG. 2 is a section through the line 2-2 of FIG. 1;

FIG. 3 is a section of a vapor generator member in accordance with the invention taken along the line 3-3 of FIG. 5;

FIG. 4 is a partial sectional view of a vapor generator member in accordance with the invention taken along the line 4-4 of FIG. 5;

FIG. 5 is a sectional view taken along the line 5-5 of FIG. 1;

FIG. 6 is a perspective view, partly broken away and partly in section at line 7-7, of a heating element in accordance with the invention;

FIG. 7 is a perspective view, partly broken away, of a vapor control member in accordance with the invention;

FIG. 8 is a sectional view taken along the line 8-8 of FIG. 5;

FIG. 9 is a diagram of electrical circuitry employed with the invention;

FIG. 10 is a sectional view taken along the line 10-10 of FIG. 2; and,

FIG. 11 is a perspective view, partly broken away, of a vapor control member in accordance with the invention;

FIG. 12 is a perspective view, partly broken away and partially disassembled, of a vapor control member in accordance with the invention; and

FIG. 13 is a schematic diagram of a method in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1-3, inclusive, a superheated vapor generation and control apparatus 10 includes a base 12 forming the bottom of a housing 14, which functions as a container to system 10. The top and sides of housing 14 are fastened to base 12

and are removable to afford access to the interior of system 10.

Controls of system 10 are disposed upon a control panel 16 on housing 14. A power switch 18, is included in panel 16 and comprises a bi-polar arrangement of conventional type controlling drawing of power from an external source, i.e., determining whether system 10 is "on" or "off," as is more fully described hereinbelow.

Disposed upon control panel 16 adjoining switch 18 is a removable line fue holder 20. A power light 22 is disposed on panel 16 and functions to indicate power in system, as more fully described hereinbelow.

Also disposed on the control panel 16 is a manual vapor heating switch 24 which participates in controlling the generation of steam and/or superheated vapor, as described. An amber vapor generator light 26 is disposed on the control panel 16 adjacent power indicator 22. Light 26 as described hereinbelow is an indicator of the operation of thermostats of a vapor generator, (described in more detail below) in the system 10.

A footswitch electric receptacle 28 is disposed in a lower part of panel 16 and accommodates a foot switch (not shown) for controlling superheated vapor production.

A power line 30 is accommodated in a fitting 32 attached to the panel 16 around a slot 34 for passage therethrough of the power line 30.

An amber heating chamber light 36 is positioned on panel 16 adjacent power light 22 and is electrically connected as described hereinbelow to remain on while a heating clement described below is drawing current. A liquid pick-up tube inlet 38 is defined in control panel 13 to receive a liquid pick-up tube 40.

At the top of housing 14 is disposed carrying handle 42. In a rear panel 46 of housing 14, an aperture 48 is defined; secured on both sides of aperture 48 is a gasket-type fitting 50. Aperture 48 and gasket 50 accommodate and receive a vapor exit pipe 52. A quick disconnect connector member 54 is disposed at an outer end of pipe 52 and connectable to a vapor control member or wand 56. The wand 56 contains a grip handle 58 in which is disposed a vapor control switch operable by a vapor control push button 60. A tube 62 extends outwardly from the control member handle 58. A vapor control power connector 64 connects between the vapor control 60 and into a socket 64 and is mounted in rear panel 46. Connected to tube 62 is a nozzle 65.

The instant disclosure incorporates by reference U.S. Patent No. 5,471,556 to Max Friedheim, inventor on the instant Application.

Turning now to FIG. 5, a support plate 66 is fastened to base 12, which in turn rests upon feet 68.

A mounting plate 70 is fastened to support 66. Fastened to mounting plate 70 is a pump 72. Pump 72 includes a cylinder 74 receiving a piston 76 which reciprocates within cylinder 74. Piston 74 is pivotably and connected to a rod 78 with a pivoting member 80 at the opposite end of the rod from the pivotable connection between the rod 78 and the piston 76. A substantially square cam 82 is pivotably attached to pivot member 80 and pivots and is rotatable on a shaft 84 mounted and pivotably journalled in plate 70. In particular applications, cam 82 is at least 7/8 inch square. This configuration of the cam 82 has been found to add leverage beyond that achieved by the device in the '037 patent and to eliminate possible vapor lock in the fluid line as fluid enters the vaporization chamber, in addition to providing more efficient prevention of back pressure of steam build-up within the vaporization chamber. This is of moment in system 10 due to the substantial heat generated in a smaller area than in the device of the '037 patent.

An electric motor 86 is mounted upon mounting plate 70 and rotates shaft 84. Electric motor 86 is wired to withstand heat generated in system 10. Cam 82 is rotated by shaft 84, which in turn rotates on a sleeve in pivot member 80. An inlet fitting 88 accommodates inflow of liquid from inlet port 38 through inlet conduit 40. A first check valve 90 is connected to inlet fitting and is shown in detail in Fig 10. As described in further detail herein below in connection with FIG. 10, check valve 90 not only blocks backflow

and prevents intake of solids into the apparatus but also affects by particular parameters the liquid content of superheated vapor produced by system 10.

An elbow fitting 92 is connected to check valve 90 and accommodates flow of liquid therethrough to a T-fitting 94. T-fitting 94 is connected to the fluid intake inlet 88. Connected to T-fitting 94 is a second check valve 100 which in turn is connected to an elbow fitting 96. Check valve 100, is identical to and is described in detail hereinbelow in conjunction with the description of check valve 90.

From fitting 96 fluid passes through a fitting 104 which is connectable to a tube 106, depicted as coiled for economy of space utilization. Tube 106 leads into a superheated vapor generator 120. A sleeve 107 is secured to tube 106 at its point of entry into generator 120. Sleeve 107 is preferably composed of aluminum and is welded to tube 106. Sleeve 107 preferably extends substantially 3/4"above the top surface of generator 120 and is secured to generator 120 at an exterior weld 109 and an interior weld 111.

A male connector 110 is fastened to screw 112 mounted in panel 16 and connected to vapor switch 24. A bracket 114 fastened to plate 12 provides support and mounting for the vapor generator 108.

Electric gear motor 86 is secured by fasteners 115 to mounting bracket 70. Electric gear motor 86 is of conventional type and in a preferred embodiment provides 366 RPM at 115 volts. Motor 86 drives pump 72 by means of cam 82 journalled on shaft 84 which in turn is driven by motor 86. A pair of buffer members 113 upon motor 106 are in contact with bracket 70 for the purpose of minimizing the effect of vibration upon the structure.

Referring in particular to FIGS. 3, 4, and 8, vapor generator 120 comprises metal castings in two parts welded together at 122 defining a vaporization chamber 126. Generator 120 is detachably positioned within housing 14 and is secured thereto at bracket 114 as noted hereinabove, and rests on washers 124 between plate 66 and bracket 114. A vaporization chamber 126 is defined centrally within generator 120. The bottom section is longer to allow room for a heating clement 132 described below. As depicted, chamber 126 is substantially spherical; however, other configurations may be employed in accordance with the invention. In the depicted spherical configuration, the periphery of chamber 126 is substantially spherical; however, other configurations may be employed in accordance with the invention. In the depicted spherical configuration, the periphery of chamber 16 is referred to on occasion as a wall. In other configurations in accordance with the invention such periphery may comprise more than one wall.

The peripheral surface 125 of chamber 16 is cut in a plurality of ridges and grooves 127, 127' respectively. The depth of the grooves 127 and the height of the ridges 127' are irregular, with the height and depth in a particular embodiment varying substantially randomly between 0.030-0.050 inch. The ridges and grooves 127, 127' are in the form of substantially concentric circles about an axis of generator 120.

In addition, cross-grain series or ridges and grooves are defined in the wall 125 of chamber 126 and denoted by numerals 128, 128'; respectively The cross-grain ridges and grooves 128, 128' are, like the ridges and grooves 127, 127' of random and irregular dimensions. The depicted structure is exemplary only, other configurations and structures (such as perforations and etching) being usable in particular applications of the invention.

Defined in generator 120 is a receptacle 130 for receiving and accommodating a heating element cartridge 132 depicted in detail in FIG. 6. Heating cartridge 132 is affixed in receptacle 130 by means of cement of conventional type which is resistant to high temperatures. Receptacle 130 is open at both ends, traversing the length of generator 120. At a receiving end, receptacle 130 defines an aperture 134 which is dimensioned to receive cartridge 132; At its opposite end, receptacle 130 opens to aperture 136 that is preferably smaller than aperture 134. Aperture 136 is dimensioned to

accommodate a pin or tamping member (not shown) for thrusting through receptacle 130 to the base of cartridge 132 thereby ejecting cartridge 132 when desired. Thus, a spent or broken cartridge can be removed for repair or replacement in an economical, cost efficient, and expeditious manner.

As depicted in FIG. 6, heating cartridge 132 is of generally cylindrical configuration. Cartridge 132 defines an included volume 138 which contains a coil of resistance wire 140. An outer sheath 142 of heating cartridge 132 is fabricated of high temperature alloy of conventional type. One end of heating cartridge 132 is closed by end plate 144; adjoining the opposite end of heating cartridge 132 is a terminal block 146. Terminal block 146 comprises a bracket for supporting a pair of leads 150, 152. Leads, 150, 152 are enclosed in temperature insulation sheaths 154, 156, respectively. Sheaths 154, 156 may be of standard material such as high temperature fiberglass for the purpose of protecting against the elevated temperatures produced by heating cartridge 132. Heating cartridge 132 has a seal 158 substantially flush with the end of cartridge 142 and comprising thermally insulated material such as epoxy or cement.

The entire generator 120 is sheathed in insulated material such as fiberglass (not shown). The heat generated is such that the entire generator normally heats to 500° F. and above, creating an oven-like effect surrounding the chamber 126 and its contents. A first thermostat 160 is

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positioned in thermal contact with generator 120; thermostat 160 is preferably set to turn off at approximately 500° F., plus or minus ten percent (10%). Electrical terminals 164 accommodate wires (not shown) connecting to the electrical system of system 10 so as to turn off the power to the heating element 132 when the desired temperature is reached. Preferably thermostat 160 is flush mounted to the generator 120 as, for example, by screwing the thermostat into a slot together with conventional means (not shown) to prevent slippage of thermostat 160.

A second thermostat 166 is depicted as positioned approximately 90° along the circumference or generator 120 from first thermostat 160. Other positions, of course, may be employed in accordance with the invention. Second thermostat 166 is mounted in generator 120 and has a pair of electrical terminals 168 connectable to the apparatus. As fully described hereinbelow, second thermostat 166 is set to cut off current to heating cartridge 132 in the event of failure of first thermostat 160 such that the temperature of the chamber 126 shall not exceed 550° F.

FIG. 7 depicts vapor control member or wand 56 in detail. Wand 56 comprises a conduit member 57, a handle member 58, a tube 62 as previously discussed connected to nozzle 65. The conduit 57 comprises braided steel cable 180 over hose 183 fabricated of heat resistant material such as that marketed under the trademark Teflon and in the preferred

embodiment is substantially 42 inches long. An insulative sheath 182 is disposed over cable 180 and electrical wires 184 are disposed therebetween preferably Teflon-coated and covered by heat insulation tubing such as fiberglass.

Handle 58 includes a central bore 188. An insulator sheath 190 is disposed around handle 58. Insulation sheath 190 may comprise rubber or other conventional material.

Disposed within central bore 188 is a continuation of cable 180 covered by insulation 182 and wires 183, 184. Switch 60 controls the operation of wand 56. Switch 60 is of conventional type, for example a single-pole spring operated mechanism. Conduit member 57 is fastened to tube 62 by fitting 198. Tube 62 is received in an aperture 200 at the outer end of handle 58 and may be fabricated of brass or other durable non-corrosible material.

Depicted in FIG. 10 in detail is check valve 90. Check valves 90,100 are identical to one another. Thus, the description herein is applicable to both. Check valve 90 defines a central bore 220 having at an input end an inlet 222 and an outlet 224 at an output end. The junction of inlet 222 and bore 220 is configured to form a seat 226 for a valve ball member 228

in bore 220. A valve cap member 230 disposed adjacent the outlet 224 defines a central bore 232 and is held by frictional engagement with inner walls 234 of bore 220. A valve spring 236 is disposed between ball 228 and cap member 230. It has been discovered that the liquid content of superheated vapor produced by the system 10 can be controlled by means of regulating check valves 90, 100 as, for example, by use of a thinner cap member 230 depressing the spring less (with smaller spring tension) such that less liquid is present in the superheated vapor whereas a thicker cap member (more spring tension) depresses the spring more, causing a greater proportion of liquid to be present in the superheated vapor.

The electrical circuitry for the system is depicted in Fig. 9. Power switch 18 controls the on/off condition of the entire system. Switch 24 is a manual vapor generator switch which as noted above is mounted on control panel 16. Wand switch 192 is actuated by push button 60 and like switch 24 controls vapor generation but is contained in the wand 56 for case of operation of the device. Switches 24, 192 control the on/off condition of pump motor 72. A terminal block 202 is fastened to base plate 12 and contains terminals 204 which provide electrical connections for the electrical circuitry of system 10.

A spark suppressor 206 is depicted as being connected with first thermostat 160 and second thermostat 166. The purpose of spark

suppressor 206 is to prevent the respective thermostats from arcing. In the event that spark suppressor 206 and the first thermostat 160 should fail, creating the danger of overheating and destruction of the unit, the second thermostat 166 at 550 ° F. will cut off. A thermofuse 207 cuts in upon failure of the second thermostat 166 and will break the generator circuit at 650 ° F.

Red light 26 is connected to be on when the first thermostat 160 has cut out while the second thermostat 166 continues to operate, thus notifying the operator of a change in condition in the system.

The white light 22 is illuminated when power switch 18 is closed (i.e. when the power switch is turned on). The amber light 36 is on when heating element 132 is drawing current. Light 36 remains on so long as heating element 132 draws current. When light 36 goes out, this indicates that generator 120 has reached its operating temperature. A foot jack switch control 208 is connected to and mounted upon the foot switch receptacle 28 on panel 16 and performs the same function as switches 24, 192. Removeable power line fuse 20 is depicted as in series with power switch 18. A relay arrangement may be employed to supply current to the heating element immediately upon actuation of any of the vapor control switches so as to maintain, in conjunction with the thermostats, a substantially constant power supply and temperature for vapor generation.

Heating cartridge 132 preferably delivers substantially 1000 watts of power to maintain temperature of the vapor generator 120 at 500° F. Other power delivery rates and operating temperatures, higher and lower, may be employed in accordance with the invention. The motor RPM is substantially equal to 366 and the pump delivery rate is preferably 4.9 gallons per hour. Other motor RPM and pump delivery rates may be employed in accordance with the invention.

The foregoing dimensions are exemplary only of the preferred embodiment and, or course, other specific dimensions may be employed in accordance with the invention.

In operation, system 10 is connected by hose 40 to source of liquid (not shown). The liquid may be any of a broad range related to the purposes for which the system 10 is to be used. In a typical cleaning context in which the system is employed to loosen and dissolve dirt as on machinery or circuit boards or in corners of a room, 100% undiluted water, distilled or deionized, may be employed. Additives such as detergents or disinfectants may be employed provided that they are stable at the operating temperatures of the system. The proportions of additives and water may be varied depending on the application. The solution may contain vaporizers, emulsifiers, degreasers, oxidants, alkalis, deodorizers, antiseptics, germicides, or the like. In addition, the liquid may comprise humidifiers, fresheners, and other reagents which the user may wish to impart to the air or to a surface or object.

Particular applications of the system include cleaning of equipment, circuit boards and/or surfaces and spaces such as rooms in connection with maintenance or janitorial work. Wand 56 provides the capability for precise direction of the vapor flow even to small objectives and in particular allows impingement of the vapor into small, confined, or relatively inaccessible objects or spaces. Apparatus in accordance with the invention provides a general purpose cleaning capability with particular applicability to remote or relatively inaccessible areas, objects and small parts.

The invention may be employed in connection with burnishing or cleaning of small parts such as time-piece apparatus, in connection with metal plating, printing and photo-engraving, lapidary and stone cutting activity, manufacture and/or repair of electronic components, removal of such things as wallpaper, labels and the like, in connection with dry-cleaning, sanitizing and sterilizing of eating implements, in connection with optical and optometric laboratory and office work, with jewelry, dental and medical offices and operating theatres, miniature instrument manufacture and repair, and biological and analytic laboratories, among many other applications. Use of apparatus in accordance with the invention is particularly advantageous in that its flexibility permits cleaning of parts to be accomplished with a minimum of disassembly, degreasing and decontamination whereby cleaning is made environmentally compatible.

A particularly useful application of the invention is in connection with the cleaning and maintenance of military equipment, including weapons and related items. This has become timely in view of the current emphasis on repair and

maintenance as opposed to acquisition of new items.

The operator directs the tube 62 toward the object to receive superheated vapor, which issues from tube 62. The superheated vapor such as steam, is "dry", i.e., having a high proportion of gas as opposed to content of fluid droplets. This has a favorable effect in that the amount of liquid included in the vapor is so small that the residue does not interfere with further cleaning and does not require a cleanup, the amount of fluid residue being so small that it can normally be readily removed by a cloth or paper towel. Pooling of liquid is virtually eliminated. The material removed by a towel in the form of a residue is easily disposed of, particularly in cases where any removed contaminants are non-hazardous or non-toxic.

By use of the invention, the operator gains the capability of precisely directing relatively dry vapor to the object targeted. The operator can control the amount of heat transferred to any target by varying the distance between the end of the tube 62 and the object of the heat, decreasing the distance and increasing the heat applied, increasing the distance and decreasing the heat applied. The invention produces a jet of superheated vapor of a temperature of approximately 500° F. at the nozzle.

Superheated vapor issues at relatively high pressure, approximately 120-200 and higher psi for single vaporization units and to at least 300 + psi for multiple vaporization generator systems as disclosed and claimed in the '009 Patent. As a result of this pressure range, the superheated vapor impinges upon, and into such relatively hard-to-reach spaces as portholes, crevices, and the like, such pressure range being greater than available with prior devices.

Recovery times of superheated vapor generators in accordance with the invention are decreased in contrast to those available with prior devices.

Relatively more rapid recovery of vaporization chambers in accordance with the invention enables employment of smaller chambers and fewer chambers (when used in a multi-chamber arrangement as depicted and described in the '009 Patent) which is useful in connection with applications requiring large and/or substantially continuous outputs of superheated vapor.

In addition, increased output pressure of superheated vapor from wand 56 results in longer and higher-volume output streams. Application of heat causes contaminants to soften, liquefy, and generally decompose or disengage from the surfaces on which they are disposed. This applies to such normally hard-to-clean substances as grease, oil, grime, paste, glue, and carbon. For removal of tenacious contaminants, heat applied by the invention initiates cleaning. Then a cleaner or emulsifier may be applied in conventional fashion at which point a further flow of superheated vapor from the invention completes removal of the contaminant.

Other applications for the invention are, among others, lubrication, particularly of relatively inaccessible and small parts. Lubrication applied in this manner is a most effective type of hot lubrication in that the surface having been first cleaned by use of the invention in a cleaning mode, the lubricant can be applied by disposing lubricant on the now clean, heated parts by conventional means and then subjecting the parts to a flow of superheated vapor, causing the lubricant to be dispersed evenly

throughout and upon the object to be lubricated.

The vapor output pressure increase due to use of improved generators including interior thermal elements affords greater flexibility and effectiveness for system 10. Output superheated vapor may be employed in a longer stream than previously feasible or with greater contact effectiveness at previous stream lengths, or a combination of these, as well as providing the capability of producing streams having greater widths and the like, much as in the variable stream patterns available with conventional garden hoses and nozzles.

A method for fabricating superheated vapor generators in accordance with the invention is depicted and described in the '556 Patent and the '037 Patent incorporated by reference herein.

Referring now to Figs. 1,10,11, nozzle 65 comprises a conduit section 238 and an outlet/vent 240.

Disposed in thermal contact with nozzle 65 is heating means 242 comprising heating wires 244 disposed in a heat insulative sheath 246. In the depicted embodiment, heating wires 244 with sheath 246 are wrapped around conduit 238; other placements and configurations of heating means 242 may be employed in accordance with the invention.

Heating means 242 is electrically connected to an independent source of

power 248 (shown schematically only) and is coupled to and regulated by an independent temperature regulator 250 of conventional type (shown schematically only), to provide and maintain a selected temperature range and to prevent burnout. Temperatures in the range 1500-2000 ° F and higher may be employed in accordance with the invention. In particular applications such temperature at nozzle 65 may be below or above the aforesaid temperature range but above the temperature at which superheated vapor enters conduit 62 from vapor generator 120, thus providing added energy and efficiency to superheated vapor issued from system 10 through vent 240.

As noted, wand 56 is connected by quick disconnect 54 to generator 120 via pipe 52. Accordingly, wand 56 is deployable separately from system 10. In particular applications, wand 56 is connectable to various vapor generators as, for example, conventional steam boilers or other vaporizing devices.

Temperature of superheated vapor issued from vent 240 may be 1500° – 2000 ° F. or higher (or lower if desired). The final product, superheated vapor substantially devoid of liquid content, may be sufficiently hot to perform numerous tasks as, for example, to melt solder and weld and in the application utilizing superheated steam vapor, without waste water, at elevated pressure of 500 psi or more with safety against explosion for any internal pressure buildup. In applications providing superheated vapor

entering conduit 62 from devices such as vapor generator 120 nozzle 65 and associated apparatus provide added energy and efficiency to superheated vapor issued from system 10 through vent 240.

A method for providing and directing highly superheated vapor includes the steps of providing superheated vapor and subjecting the superheated vapor to means for further heating and directing the superheated vapor.

There have therefore been provided an improved highly superheated vapor generator and control system and method. Though a particular embodiment has been described and depicted herein, the scope of the invention is defined by claims to be filed pursuant to law and interpreted in light of the specification and drawings.